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Gender differences in Pakistani high school students' views about science

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Abstract

This study examined gender differences in 100 Pakistani high-school students' attitudes towards science subjects, their perceptions of science and scientists, and their views about majoring in science. The study was also aimed to identify some of the factors underlying females' under representation and low participation in science reported in previous research studies. Questionnaire developed by Miller, Blessing and Schwartz, 2006 was adapted for data collection. The questionnaire consisted of three parts. In its 1st part, a list of thirteen subjects being taught at matriculation level was given to choose from. In 2nd part, they were asked to name their favourite and what they liked most and least about that particular subject. Finally, they were asked five open ended questions regarding their college major and other matters related to science. Educational implications are also discussed.

Keywords: Gender; attitude; physical sciences; biological sciences.

1. Introduction

Our society is not yet on the stage where males and females could enjoy the equal status in the field of science (Darbyshire, 2009). Rosser and Lane (2002) authenticate this fact by highlighting four barriers to retaining female scientists and engineers: pressures women face in balancing career and family, problems faced by women because of low numbers and stereotypes held by others regarding gender, issues faced by both male and female scientists and engineers in the current environment of tight resources. The effect of these barriers is observable in underrepresentation of women in most areas of science and engineering. In 2006, more than half (53%) of psychology postdocs, 46% of social sciences postdocs, and 41% of biological sciences postdocs were women. Fewer than 25% of postdocs in computer sciences, engineering, mathematics, and physical sciences were women (NSF, 2008). The state of affairs is somewhat encouraging at lower levels as George (2000) discovered that students' attitudes toward science generally decline over the middle and high school years. Despite the fact that women now

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outnumber men on graduate courses, there continues to be a gender divide at higher academic levels with only 23% of women reaching the rank of professor (Flicker, as cited in Darbyshire, 2009) because of lower doctoral degrees received (NSF, 2008) and barriers faced by women scientists (Rosser & Lane, 2002). Osborne (2003) identified gender, personality, and structural variables and curriculum variables as factors influencing attitudes towards science. Of these the most significant is gender.

One of the challenges of science attitude research is that many studies have been inconsistent in their results. Some researchers conclude that gender difference exists as far as attitude towards sciences is concerned (Lee, 1998; Osborne, 2003). Boys have a more positive attitude toward science than girls. Boys show significantly better attitudes regarding interest in science classes and activities in science classes, confidence in ability to do science, and interest in science-related activities outside of school (Ornstein, 2005). On the other hand, some researches reveal that there is no gender difference (Vrcelj & Krishnan, 2008; Penwell, 2004; Çokadar & Külge, 2008; Kögce, Yıldız, Aydın, Altındag, 2009). Between these two extremes there are some researches which found that this difference varies with regard to some other variables. Iqbal, Nageen & Pell (2008) explored gender differences in attitudes towards science in urban and semi-urban locations and provided evidence of the potential of girls in the latter areas. Prokop, Tuncer and Chudá (2007) studied Slovak students' attitude toward biology through six dimensions; interest, career, importance, teacher, equipment and difficulty and came across the gender difference among the students of grade 5-7 but not among 8-9 grade students. Akpınara, Yıldıza, Tatarb and Ergina (2009) explored that there were significant differences between female and male students in terms of "interest in science" in favor of female. However there were no significant gender differences in terms of other factor "enjoyment of science", "anxiety", "enjoyment of science experiments" respectively.

Literature depicts that students show different attitudes towards different science subjects. Polarization between life science and physical science courses in girls' and boys' choices for themselves respectively is clearly visible. Girls tend to select Biological Sciences whereas boys have a propensity to select Physical sciences (Cameron, 1989; Murphey & Whitelegg, 2006; NSB, 2002; NSF, 1999; Miller, Blessing, Schwartz, 2006). On analyzing the reasons given by students for opting particular science subject, it was observed that Physical sciences were mostly chosen for utilitarian reasons while personal interest was involved for choosing biological sciences (Cameron, 1989; Murphey et al., 2006). Other reasons for choosing science courses were attainment of expertise in their respective fields to further their education, to improve job skills (Vrcelj & Krishnan, 2008), interest in the subject, college course requirement and a variety of career ahead (Regan & Childs, 2003). Mothers of the students proved to be the individual who most influenced the students to choose a career in science, with fathers ranking as second most influential (Tompson, Rogers & Edeburn, 1999; Coyle, 2006). Literature recounts why girls choose not to pursue science even though they are both competent and believe in their capabilities to succeed. Osborne (2003) refers to the feminist perspective on this. Likewise, a lack of networking, role models, retention programs (Vrcelj & Krishnan, 2008), boring content, having no future relevance (Coyle, 2006), a gap between young girls' desire to observe common scientific phenomena and their opportunities to do so (Kahle as cited in Osborne 2003) are some other causes of female under representation in science. To understand what influence this phenomenon has on students' attitude towards science in Pakistan. This study is aimed at exploring the gender differences in high-school students' visions concerning science. High school appears to be a critical time for science-related experiences. Because gender differences in interest in science are initially small in middle school, but become substantial during high school (Jones et al. as cited by Miller et al., 2006), it is important to focus on this period.

2. Method

2.1. Sample

100 10^{th} grade students were selected as sample from two pilot schools i.e. pilot school for girls and pilot school for boys. 50 girls and 50 boys constituted sample of the study. The students were enrolled in English medium science section. Questionnaires were given to them during their Physics class.

2.2. Material and procedure

There were three parts of the questionnaire which was adapted with permission from the study of Miller et al. (2006) with the title "gender differences in high school: students' views about science". In its 1st part, a list of thirteen subjects being taught at matriculation level was given to choose from. Students were instructed to rank order the courses according to their choice. In 2nd part they were asked to name their favorite subject (which could have been out of the given list also) and what they liked most and least about that particular subject. Finally, they were asked five open ended questions regarding their college major and other matters related to science: (1) which major subject would you choose, when you enter college, (2) why would you decide to choose that particular subject, (3) would you consider science as major, why (or why not?), (4) more males than females tend to be scientists, if yes, why and (5) were males and females different in their study habits, thinking and learning styles?

3. Results

Results of all the questions are given below in the same order in which they were asked in the questionnaire.

Table 1. Ranking of the subjects from the given list

	Mathematics	English	Biology	Physics/ Chemistry	Others
Males	20%	34%	2%	30%	12%
Females	44%	30%	10%	0%	14%

Urdu, Computer Sciences, Home Economics, History and Geography were not selected by even a single student. Females liked Mathematics more than males did when males liked English more. Females showed obvious preference for Biology whereas males did it for Physics and Chemistry. Fine Arts, Pakistan Studies and Islamiyat were not preferred by enough students to permit analysis.

Table 2. Favorite Subject

	Biology	Mathematics	Physics/ Chemistry	Social Sciences	English	Computer Sciences
Male	14%	26%	24%	8%	22%	4%
Female	16%	44%	0%	6%	28%	4%

Favorite subjects were sub divided into five groups for the sake of analysis: Biology, Mathematics, Physics and Chemistry, Social Sciences and English. A prominent gender difference was visible again for Mathematics and Physical Sciences (Physic and Chemistry). Females (44%) preferred Mathematics whereas males were the only who chose Physics and Chemistry which were not chosen by even a single female.

Table 3. What liked most and least

	Liked most			Liked least			
	Content	Teacher	Others	Specific Content	Teacher	No difficulty	Others
Male	68%	4%	26%	38%	6%	40%	14%
Female	70%	20%	6%	74%	0%	16%	8 %

Two major factors seem to contribute prominently towards subject likeness: content and teacher. Males and females mentioned the first reason almost equally. They differed in their opinions of teacher as motivating force. A notable gender difference was found in response to last question when a great number of males (40%) mentioned no difficulty about the particular subject whereas most of the females (74%) found some particular content area difficult.

Table 4. Anticipated major

	Biology (doctor)	Mathematics (Engineering)	I.Com (Commerce)	Computer Sciences	Science	Others
Male	14%	36%	24%	8%	10%	8%
Female	40%	32%	0%	12%	4%	12%

The responses were classified into five groups for the sake of analysis: Biology (pre medical), Mathematics (pre engineering), commerce (I.Com), Computer Sciences (ICS) and others. Females (40%) wanted to opt for Biology to enter the field of medicine more that males did. Contrary to that there was no significant difference as far as

Mathematics to enter the field of Engineering was concerned. Commerce was the field which was selected only by males. Overall, the best part of students (78 %) wanted to select science for further studies with higher number of female students (males=68%, female=88%).

Table 5. Why the particular major

	Personal interest	Career orientation	Parents/ relatives	Others
Males	18%	56%	4%	20%
Females	20%	56%	16%	6%

Career orientation and personal interest were the major contributing factors for both the groups. No gender difference emerged in this case. Parents'/ relatives' influence was relatively more on females.

Table 6. Why or why not science major

	Science not as major (m=15, f=6, t= 21)				Science as major (m=35, f=44, t= 79)	
	Difficult	Low marks	Lack of facilities	No interest	Personal interest	Career orientation
Males	14%	4%	4%	8%	22%	48%
Females	0%	0%	0%	12%	40%	48%

As noted earlier, more females than males (m=68%, f=88%, t= 78%) decided to major in science because 24% boys selected Commerce. Foremost reasons for not majoring in science disclosed by males were difficult content, low marks, lack of facilities and no interest. Females (12%) in this category referred to disliking science.

Table 7. More boys than girls tend to be scientists

	It's not so	No interest	Wedding	Social constraints	Preferential treatment
Males	18%	10%	0%	26%	32%
Females	14%	22%	16%	28%	22%

An equal number of male and female students (m=18%, f=14%) disagreed to the statement. Majority of the students irrespective of their gender agreed. Replying against why it was so, they explained the phenomenon in terms of females' lack of interest in science, their responsibilities of married life, their domestic responsibilities even before marriage, social constraints and norms, lack of facilities especially for female education, males' preferential treatment not only by parents but also by society, and males' greater intelligence level (more curiosity, skill orientation and working capacity).

Table 8. Mental differences between male and female

	It's not so	Girls responsible/ boys careless	Boys' intelligence	Girls' intelligence	Different aims	Different environment	Cognitive styles
Males	30%	16%	14%	6%	4%	8%	8%
Females	2%	58%	14%	10%	0%	8%	8%

A great gender difference emerged when only one female opposite to fifteen males declared that there exists no mental difference. A great number of students (37%) mentioned them. They thought female students to be more careful, responsible, serious and emotional as compared to male students who were careless, irresponsible and tension free. 44% students mentioned differences in intelligence. Males were considered to be more curious as well. An equal number of students mentioned that females thought emotionally when males did it rationally.

4. Discussion

The present study is aimed at exploring the gender differences in interest, involvement and contribution in science in Pakistani perspective. Traditional extremes of physical sciences and biological sciences for males and females respectively have been observed in this study as well. High school females liked mathematics more than did males and there is no prominent difference in English as their favorite subject. The findings are inconsistent with that of previous researches which show that Mathematics is male dominant while English (Language and Literature) is a female dominant course (Miller et al., 2006; Du, Weymouth, & Dragseth, 2003). In addition, they more often planned to major in science in college, especially in the areas of biological sciences. Besides, the current study

exposed some of the intricacies fundamental to these gender dissimilarities. It was surprising that no female mentioned science to be tough as boys did. So, science is no more a male dominant area. It is clearly indicated that what counts more while choosing a major are interest and future concern rather than ability, gender or self concept. Traditionally, students see only three major areas as helpful in selection of career path: biology for entering in medical field, mathematics for engineering and I.Com for commerce. Gender discrimination is prominently evident in medicine and commerce for males and females correspondingly. Not a single female decided to go for I.Com. It is also interesting to note that no students except one female wanted to enter the traditional teaching profession.

As far as female scientists' contribution to the scientific field is concerned, almost the same reasons of their lower partaking came forward which are mentioned by (Rosser & Lane, 2002). Besides, there is a societal image that expects boys to be more interested in science (Du, et al., 2003). These restrictions for girls and preferential treatment for boys makes girls less interested in involving in scientific field. It is a consensus among students that there are prominent personality differences which cause different attitudes towards science. Female students are more careful, responsible, serious and emotional as compared to male students who were careless, irresponsible and tension free. Du, et al. (2003) also declared the girls to be more engaged in school and classroom learning, hard worker and more recognized than boys. Summing up, it can be said that regarding attitude towards science, optimistic picture is appearing in Pakistan. Female students are enthusiastic, fervent and zealous towards selecting science areas. If they are facilitated properly, we can get a better partaking on their behalf which will ultimately flourish and enrich the field of science. Further research in this area may be done by taking comparatively large sample and including interviews for further exploration of the students' views.

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